UNIVERSITI TEKNOLOGI MARA

APPLICATION OF Pb-210 DATING METHOD FOR RECENT SEDIMENTATION AND HISTORY OF METALS CONTAMINANT IN A FORMER TIN MINING LAKE

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledges as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

Former tin mining lakes are recent fresh water man-made lakes. The lakes were suspected to have high sedimentation rate and anthropogenic toxic metals due to past mining activities and recent human activities in and around the lake areas. Sedimentation in lake occurred through run-off from the land surface and settles on the bottom lake. Increasing of interest on metals contaminant in the sediment lakes was due to the fact that sediment can act as sink and storage of heavy metals. Profile of metals against sediment depth enables us to obtain valuable information about environmental and deposition of contamination in that area. The study involved depth profiling of Pb-210 and metals concentration and then applying Pb-210 dating technique to estimate sedimentation rate, history of metals input and modeling of contaminants. The sediment cores were sampled from a former tin mining lake in Kampung Gajah, Perak, by using gravity corer. The sliced cores were then analyzed using alpha-spectrometry and Neutron Activation Analysis (NAA) technique to determine activity of Pb-210 and concentration of Al, As, Co, Cr, Fe, Mn, Zn, Th and U. Result showed activity of Pb-210 for sediment cores ranged between 175.48 Bq kg^{-1} - 450.96 Bq kg^{-1}. From this study, sedimentation rate and Pb-210 inventory is depending on the contour of lake. Pb-210 flux in the study area showed the highest value as compared to atmospheric regional and global value. It seems high in situ production of Pb-210 and emitted radiation in the study lake. Application of Pb-210 has successfully dated age of sediment back to about 60 years ago (~1950 – 2007) that corresponded to the stoppage of mining activities at the study area. Study in metals profile showed Al, As, Co, Cr, Fe, Mn, Zn, Th and U within the sediment lake were relatively higher than concentration of reference site. Enrichment factor (EF) value employed to estimate the degree of contaminant in the lake sediment indicated As, Th, U and Zn are enriched in lake sediment as compared to Co, Cr, Fe and Mn elements. Comparison to sediment guidelines, earth crust and reference site showed lake sediment is highly contaminated by As, moderate contamination by Zn and slightly contaminated by Cr and Mn. While, Th and U concentration showed relatively higher as compared to earth crust composition and reference site. Application of Pb-210 dating method enables to construct chronology of metals history. According to chronology of metals history showed most of metals increased to the recent years. This findings are likely due to anthropogenic input such human activities, atmospheric emission from fossil fuel and industries, cutting, slashed and burn of trees, clearing of land for agricultures, road construction and beginning of agriculture activities started during late 1980s. Correlation and cluster analysis were used to show origin source of metals. Porosity analysis of sediment cores showed compaction effect could be negligible. Modeling of contaminant modeled using emission of Pb-210 with relating to metals concentration derived using simple linear regression model. The derived equation could be used to predict either through metal concentration or radionuclides activities to the similar location as an assessment for monitoring and management practice.

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CHAPTER 1

INTRODUCTION

1.1 Preamble

Mining areas were identified to left undesirable marks to the environment due to presence of natural radioactive material contained in minerals and excessive level of heavy metals. Major sources of metals contamination in former mining areas are suspected from remaining tailing of past mining activities (Seen *et al.*, 2004; Taylor, 2007). In mining areas, process of metal mining, smelting and processing introduced soil and lake with metals contaminant. The contamination delivered into the environment through gaseous, particulate emission, liquid or solid waste. The ionizing radiations are emitted from decay of U-238 and Th-232 series. Uranium and Thorium are naturally occurring radioactive material that naturally presence in rocks, soil and water all over the earth (Al-Salleh, 2007). High concentrations of Ra-226, Pb-210 and Po-210 radionuclides are believed to have carcinogenic effect especially when they enter the food chain (Zal U'yun *et al.*, 2005; Matthews *et al.*, 2007). Numerous studies have suggested that long term exposure to radiation especially exposure through ingestion and inhalation such as Po-210 and Rn–222 will potentially affect human health (Li *et al.*, 2006; Matthews *et al.*, 2007).

In recent years there has been an increasing study in radioisotope ratio to determine anthropogenic input (Seen *et al.*, 2004). Ratio of lead isotopes such as Pb-206, Pb-207 and Pb-208 are widely employed as isotopes finger prints for lead ores (Seen *et al.*, 2007). Some other elements such as Pb-210 and Po-210 have been widely used as a tracer to date sediment age, sedimentation and accumulation rate in aquatic